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Division of Canada & Dominion Sugar
Co. Ltd.

THE BADGER SYSTEM

... a trenchless method
of laying pipe, drains,
cables and conduit

A revolutionary new trenchless system for the underground installation of drains, conduits and pipes of all sizes is now available to agriculture and industry through a division of Canada and Dominion Sugar Company Limited.

Known as the Badger System, it incorporates important refinements of mole-ploughing techniques and equipment developed in England by Hudswell Badger, Ltd.

This method offers precision, quality and economy in constructing small and medium diameter drains and pipelines, unmatched by conventional underground installation methods.

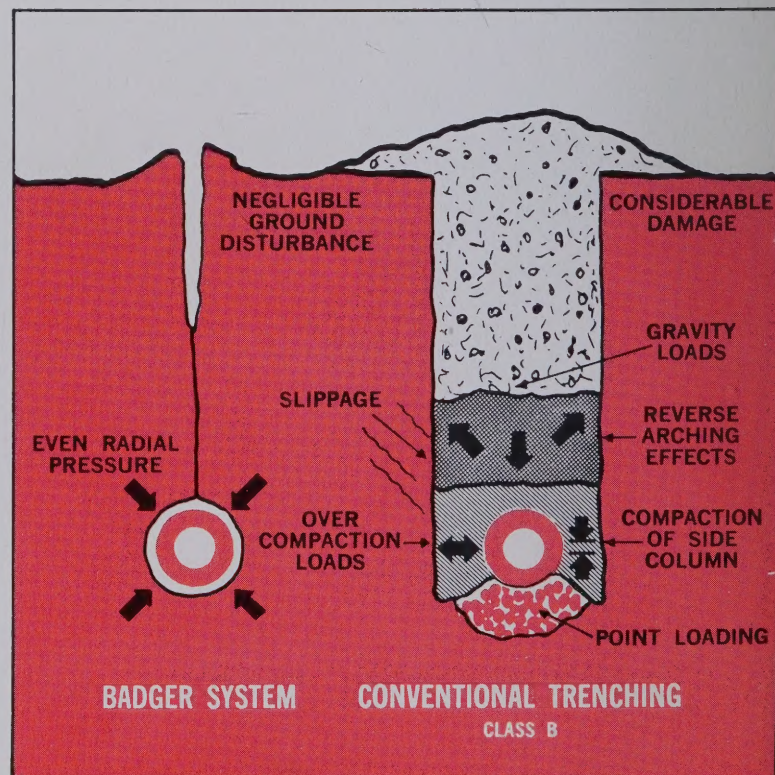
The Badger System is being provided throughout Canada on three bases:

- The division will act as a sub-contractor for installation of drains, conduits and pipelines.
- The division will rent equipment, supplying both operational training and supervision.
- The division will lease equipment to firms familiar with its use.

The technical resources and background, gained from years of experience by Hudswell Badger, Ltd. of England, is ensured and available to potential users.

Enquiries should be addressed to:

Badger Systems Division,
Canada and Dominion Sugar Company Limited,
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WHAT IS THE BADGER SYSTEM?

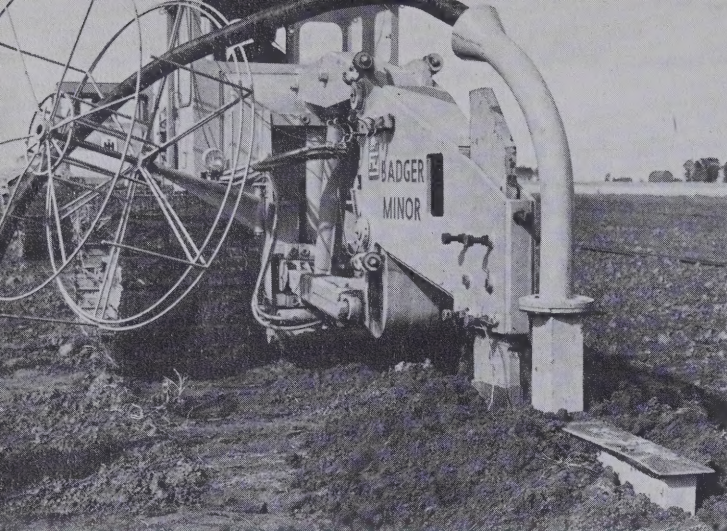
Key to the Badger System of trenchless pipelaying is the unique mobile-mounted equipment which tunnels a passage through the ground by means of a narrow blade of special design, replacing the conventional method, involving excavating a trench, laying pipe and then backfilling the excavation.

An installation unit comprises two machines. On one . . . called either the Badger Major or the Badger Minor, depending upon the diameter of pipe it can lay and the depth to which it is to be installed . . . is the equipment for forcing the passage or tunnel through the ground. Included is the equipment needed to feed the pipe into the passage or to pull it through the tunnel behind it, as well as other equipment to ensure, automatically, that the proper gradient and alignment are maintained.



Top: Badger Minor in tandem with Tugmaster laying four-inch land drainage pipe.

Bottom: Badger Major installing 12-inch pipe at a depth of six feet.



Badger Minor laying four-inch land drain pipe with pipe being fed from ground into pipe-laying duct.



Badger Minor showing the unique blade and pipe-laying duct.



Tugmaster with front mounted anchor and winch. Pipe has just been laid under ground in front of anchor blades.

The second machine . . . known as the Badger Tugmaster . . . is a tractor specially-equipped to provide extra traction for the Badger, either by towing or winching, in heavy soil conditions.

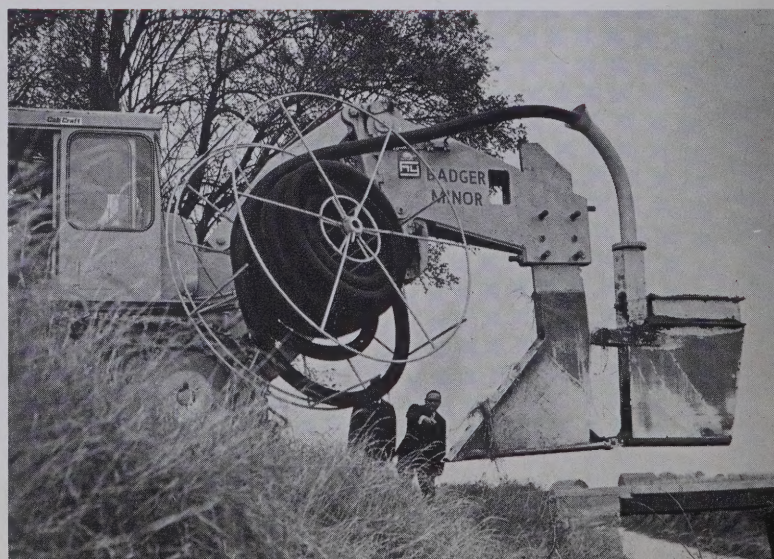
For light agricultural work or for pipeline laying involving relatively small diameter tubing . . . up to 4" in size . . . flexible piping is fed down into the tunnel under the ground through a duct leading to the end of the special blade. Pipe can either be laid out ahead of the Badger or, if desired, fed from coils carried on the Badger itself.

In the case of installations using larger diameter rigid pipe . . . to 12" or 18" . . . at depths of up to nine feet, an expander is appended to the trailing end of the special blade. The pipe is attached to this expander and is drawn into the ground smoothly through the tunnel formed behind the blade, in lengths of 600 feet or longer without a break, as the Badger moves forward. An access hole is required at the start of lines under these circumstances.

The secret of the system is the marrying up of the rugged machinery required to transmit the immense draught forces mustered with the delicate control and optical reference means which have been built in.

The Badger System can be used for practically any type of pipeline, conduit or cable network with diameters up to 18", using rigid or coiled material.

When working from a drainage canal or ditch, Badger Minor requires no access trench.



Multiple tunnels can be made simultaneously in some instances, a capability of particular significance to the communications industry. Employing additional ducts, more than one expander and certain other special techniques, several pipes and cables, or a combination of both can be put underground at one time.

Only two limitations apply to the type of pipe, conduit or cable which can be installed . . . it must be strong enough to be pulled in long lengths without breaking and any jointing system cannot extend excessively from the outer surface. Polyethylene, polyvinyl chloride and steel are the pipe and conduit materials most commonly installed by the Badger System.

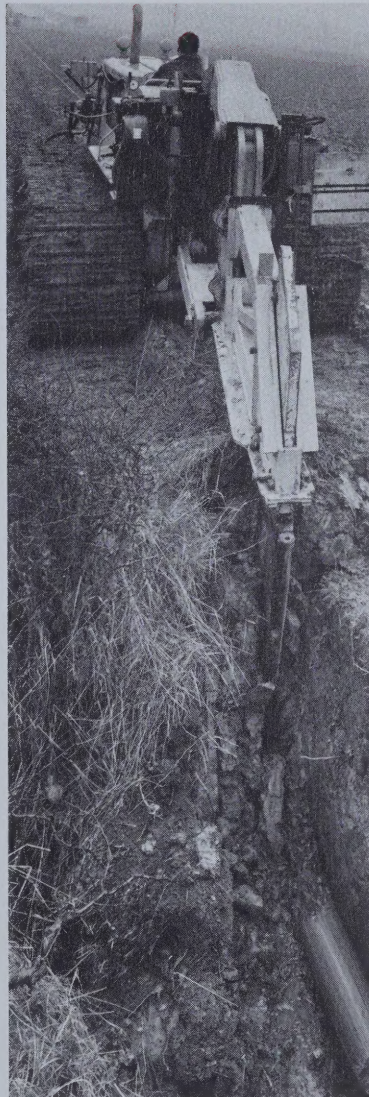
Water systems, including main lines and distribution; irrigation, drainage, gas and products pipelines, including transmission and distribution; communications and power cables are among the underground installations which can take full advantage of Badger System technology.

The Badger can be used for shallow river crossing, or installations in the beds of shallow lakes or ponds, as well as in the wide open spaces or more congested urban areas.

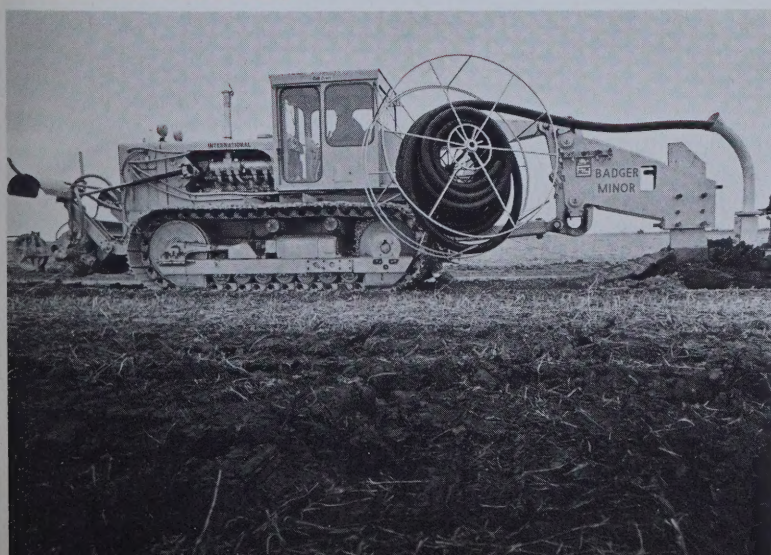
Quite obviously, a major advantage in urban installations is speed. At the same time, restoration costs are substantially less than those incurred in conventional methods.

Top: In using the Badger System, rigid pipe or pipe of larger diameter is attached to an expander and drawn into the ground either singly (left) or in multiples (right).

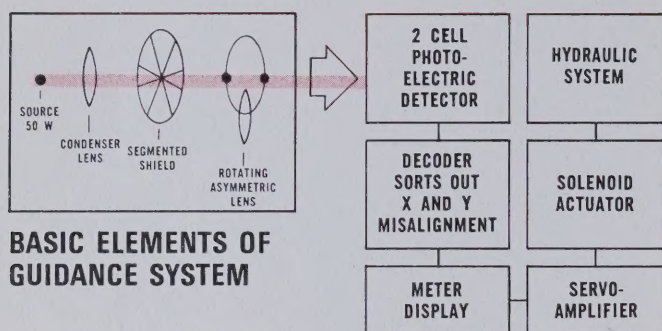
Bottom: Badger System can lay pipes of all types across small rivers or swampy land without problems.



Badger Minor laying flexible land drainage pipe from 500-foot reels carried on the machine itself.



GRADIENT AND ALIGNMENT CONTROLS



Certain pipeline installations, particularly those used for gravity drainage or fluid transmission, require extreme accuracy in regard to both gradient and alignment.

To ensure such requirements are met, close tolerances are maintained by a radio control unit mounted in the cab of the Badger Minor and a ground operator with a surveyor's level and a remote radio control unit.

An optical tracking device has been developed for use with the Badger Major, which is capable of larger installations with much more stringent requirements. This system will also be available for use with the Badger Minor during 1970.

A light source . . . a battery-powered 60-watt bulb, shining through a condenser lens and then through a segmented circle which divides the light into 40 separate beams . . . is set and levelled on the proposed line of the pipe. The beams are scanned by a rotating, asymmetric lens at the source as they cross two photo-electric cells mounted on the Badger.

The photo-electric cells, placed vertically one above the other, receive this information, forward it to a decoder which reacts to the frequency modulation and phase difference between the two cells rather than to the amplitude of the signal. Polar coordinates are resolved and displayed on vertical and horizontal motors and simultaneously passed through a servo-amplifier which actuates the Badger's hydraulic control system . . . bringing an immediate response in levels, depths and direction of the blade.

The light beams have a range of about 2,000 feet and, because the photo-electric cells are most sensitive in the infra-red region, the system is effective even in conditions of poor visibility. While the system normally provides both steering and elevation control, it can be used effectively to provide a plane reference rather than a line, enabling the Badger to operate on a variable path without eliminating control of the vertical direction.

BADGER MINOR

The Badger Minor has a blade enabling it to work to a depth of 5 feet, 6 inches. It can handle flexible drainage tube to a diameter of 4" or larger, or polyethylene or P.V.C. rigid tube to a 12" diameter. It is also capable of laying metal piping, conduit or coated materials.

The Badger Minor has its own self-contained hydraulic winch which is used for self-haulage. Utilized in this manner, it has a good rate of production and, coupled with a Badger Tugmaster, can lay pipe of any type under virtually all conditions at a rate far in excess of that possible using conventional methods. Under certain conditions, the Badger Minor can lay pipe as fast as 100 feet per minute.

BADGER MAJOR

The Badger Major is a much larger version of the Badger Minor. It is specifically designed for the installation of gravity drainage, particularly sewage schemes. The requirements here are much more stringent since the pipes must be laid to very close tolerances not only to grade, but also to alignment over 2,000 feet. The Badger Major, using the trenchless method, is also hauled by its own self-contained hydraulic winches with a pull of up to 320,000 pounds. The blade is able to go to a depth of 9 feet with a length of pipe normally installed between manholes of 300 to 360 feet. The manholes themselves can be constructed and connected conventionally to the sewer pipe.

The Sitehustler, a mobile anchor used with the Badger Major in a similar manner to the Tugmaster used with the Badger Minor.



BADGER PLUSES

With the Badger System, no trenching, apart from a short access excavation at the start of each line, is required. Even this is unnecessary, if a drainage ditch or canal is available.

The Badger is able to work in any ground condition, excepting solid rock or situations where large boulders block the line. It performs dependably in waterlogged soils, swamps, running sand or silt, clays or gravel genial soils. Track-mounted anchor units and flotation pads are used on extremely marshy land and function satisfactorily under the worst possible conditions, including situations where open trenching would be impossible.

Both below and above ground, soil disturbance is minimal. This means that soil structure is unaffected and surface damage is minor, thus reducing objections from landowners and residents, making problems encountered in obtaining right of way much less.

With the Badger System, the defects of trenching work, connected with uneven loadings and stability, are avoided completely. Shortly after laying the pipe through the circular tunnel, the ground comes into contact uniformly with the pipeline to form a cushion, giving even support. The strength of the pipe being laid has to be sufficient to resist the ground pressures involved but, in general, the position with regard to bedding factors, pipe strengths and resistance to ground pressures is very favorable to the Badger System technique, particularly in unstable soils.

While physical conditions, pipe diameters and pipeline depth dictate the speed with which pipe can be laid, its overall superior performance compared with the orthodox methods is of major importance. Laying 8" high pressure P.V.C. pipe to a depth of 5 feet, 6 inches can be done at a rate of up to 6,000 feet per day. Depending on conditions, 10,000 to 25,000 feet of 4 inch flexible polyethylene drain can be laid in a day.

The speed with which the Badger can operate is a special advantage in unfavorable ground conditions such as running sand, where there are normally such problems as flotation, sinking and dewatering. It has been shown that with the Badger System, there is greatly reduced risk of flotation or sinkage of the pipe in ground of this nature. In fact, to date, no installation has resulted in any movement whatsoever.

The speed and effectiveness obtainable in bad ground results in costs being proportionately reduced, producing substantial savings in total capital costs.

Automatic control methods maintain depth, gradient and pipe direction with outstanding accuracy, minimizing the possibility of human error. Grading is achieved in a single operation.

The prospect of dependable pipeline performance, throughout its life span, is increased by superior bedding and accuracy of alignment and grade.

BADGER SYSTEMS DIVISION

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